EARTH CONNECTION STRUCTURE, EARTH CONNECTING MEMBER AND EARTH CONNECTION METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to the structure for connecting earth on a substrate to a compensating member for compensating for an area of the earth, and relates also to a member and a method for connecting earth to the compensating member.

Description of the Related Art

As a method for restraining the EMI (Electro Magnetic Interference) of electronic units, a method for increasing the area of the ground (the earth) is well known.

In a technique disclosed in Unexamined Japanese Patent Application KOKAI Publication No. H11-204162, an enlargement ground member for compensating for the area of the ground is fixed into the casing, and a substrate of a circuit and the enlargement ground member are fixed by metal screws, etc. The metal screws are in contact with the ground of the substrate, so as to electrically connect the ground and the enlargement ground member.

To lower the impedance between the ground and the enlargement ground member, it is necessary to connect the ground and the enlargement ground member at a plurality of points.

In the case where the metal screws are employed in the above structure, the ground should be connected with the enlargement ground member using the plurality of metal screws. According to the technique disclosed in the above publication, other than those screws necessary for fixing the substrate to the enlargement ground member, a large number of metal screws are necessary for lowering the impedance between the ground the enlargement ground member.

To maintain the electric connection between the ground and the enlargement ground member, bosses which catch the metal screws need to be prepared on the enlargement

ground member. That is, in the case where the plurality of metal screws are employed, a plurality of bosses need to be prepared on the enlargement ground member.

As described above, according to the technique of the above publication, a large number of component parts for connecting the ground of the substrate with the enlargement ground member are required. Hence, the structure for connecting the component parts will inevitably be complicated, and a large number of connection processes are required.

The entire contents of Unexamined Japanese Patent Application KOKAI Publication No. H11-204162 are incorporated herein by reference in its entirety.

SUMMARY OF THE INVENTION

The present invention has been made in consideration of the above. It is accordingly an object of the present invention to provide the earth connection structure, earth connecting member, earth connection method for easily connecting earth of a substrate to a compensating member for compensating for the area of the earth.

In order to attain the above object, according to the first aspect of the present invention, there is provided an earth connection structure comprising:

a substrate, on whose surface earth is formed;

an earth connecting member which is connected to the earth; and

a compensating member which compensates for an area of the earth and is joined to the substrate such that the earth connecting member is sandwiched between the compensating member and the substrate, and

wherein the earth connecting member has elasticity, contacts the compensating member by being sandwiched between the substrate and the compensating member, and electrically connects the earth with the compensating member in a low impedance state.

According to this structure, the earth of a substrate and a compensating member for compensating for the area of the earth can easily be connected with each other.

The earth connecting member may comprise:

a base which is connected to the earth; and

a spacer which is arranged on the base and has elasticity.

The substrate may has at least one through-hole for fixing the earth connecting member on the substrate; and

the base may include at least one lead, which is inserted into the at least one through-hole and connected to the earth.

The at least one lead may have elasticity and a protruding portion for fixing the earth connecting member onto the substrate.

The base may have at least one lead having a margin, left for being connected to the earth and formed in parallel with surface of the earth.

The spacer may include a plate spring.

The spacer may include a coil spring.

In order to attain the above object, according to the second aspect of the present invention, there is provided an earth connecting member, which is arranged between a substrate and a compensating member which compensates for an area of earth formed on the substrate, and which electrically connects the earth and the compensating member, and the earth connecting member comprising:

a base which is connected to the earth; and

a spacer which is arranged on the base and has elasticity, and

wherein the spacer is in contact with the compensating member, in a state where the earth connecting member is sandwiched between the substrate and the compensating member, and electrically connects the earth and the compensating member in a low impedance state.

The substrate may have at least one through-hole for fixing the earth connecting member onto the substrate;

the base may have at least one lead to be inserted into the at least one through-hole; and

the at least one lead may have elasticity and a protruding portion for fixing the earth connecting member onto the substrate.

The base may have at least one lead having a margin, left for being connected to the earth and being in parallel with surface of the earth.

The spacer may include a plate spring.

The spacer may include a coil spring.

In order to attain the above object, according to the third aspect of the present invention, there is provided an earth connection method comprising:

connecting an earth connecting member having elasticity and conductivity, to earth formed on a substrate; and

arranging a compensating member for compensating for an area of the earth, on the substrate such that the earth connecting member is sandwiched between the compensating member and the substrate, thereby electrically connecting the earth and the compensating member via the earth connecting member in a low impedance state.

BRIEF DESCRIPTION OF THE DRAWINGS

These object and other objects and advantages of the present invention will become more apparent upon reading of the following detailed description and the accompanying drawings in which:

FIG. 1 is a diagram showing the positional relationship of an earth connecting member, an internal substrate and a chassis;

FIG. 2 is a cross sectional view showing a state, in which the internal substrate on which the earth connecting member is mounted is fixed onto the chassis;

FIG. 3 is a diagram showing the structure of an earth connecting member according to the first embodiment of the present invention;

FIG. 4 is a diagram showing a method for fixing the earth connecting member onto the internal substrate;

FIG. 5 is a diagram showing a method for fixing an earth connecting member,

according to the second embodiment of the present invention, onto an internal substrate;

FIG. 6 is a diagram showing the structure of the earth connecting member according to the second embodiment;

FIG. 7 is a diagram showing another structure of the earth connecting member according to the first embodiment of the present invention;

FIG. 8 is a diagram showing a state wherein a plurality of earth connecting members are fixed onto the same internal substrate; and

FIGS. 9A to 9C are diagram showing various shapes of a metal spacer included in the earth connecting member.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An earth connecting member according to the first embodiment of the present invention will now be described with reference to the accompanying drawings.

The earth connecting member of the first embodiment electrically connects earth wiring formed on the internal substrate of an electronic unit with a chassis used as a compensating member for compensating for the area of the earth.

FIG. 1 is a diagram showing the positional relationship of an earth connecting member 1, an internal substrate 2 and a chassis 4.

As shown in FIG. 1, the earth connecting member 1 is installed on the back surface of the internal substrate 2, and connected to the earth wiring 3 formed on the front surface of the internal substrate 2. The earth connecting member 1 is sandwiched between the internal surface 2 and the chassis 4, thereby electrically connecting the earth wiring 3 and the chassis 4.

The internal substrate 2 has a plurality of through-holes 7 for fixing the earth connecting member 1 on the internal substrate 2 and a screw hole 8 through which a screw 6 for fixing the internal substrate 2 on the chassis 4 passes.

The plurality of through-holes 7 are formed in such positions that the earth connecting member 1 can be soldered on the earth wiring 3 so as to be connected thereto.

Various electronic units (not illustrated) are mounted on the surface of the internal substrate 2.

The chassis 4 is made of metal having conductivity, and has a boss 5 into which the screw 6 is inserted.

The internal substrate 2 is fixed on the chassis 4, if the screw 6 is inserted into the boss 5, through the screw hole 8. In this structure, as shown in FIG. 2, the earth connecting member 1 is sandwiched between the internal substrate 2 and the chassis 4.

Note that only one boss 5, one screw 6 and one screw hole 8 are shown in FIG. 1. However, a plurality of bosses 5, a plurality of screws 6 and a plurality of screw holes 8 may be prepared, if they are necessary for fixing the internal substrate 2 onto the chassis 4.

The structure of the earth connecting member 1 will now specifically be described.

As shown in FIG. 3, the earth connecting member 1 comprises a base section 10 and a metal spacer 11.

The base section 10 has a plurality of leads 12 to be inserted into the respective through-holes 7. The leads 12 are inserted into the respective through holes 7 from the back surface of the internal substrate 2, as illustrated in FIG. 4, and then soldered on the earth wiring 3. Thus, the base section 10 (at least the leads 12 included therein) are formed from materials (e.g. copper, tin, etc.) which have conductivity and which can easily be adhered to solder.

The metal spacer 11 is connected to the base section 10 using a connection method (e.g. spot welding, etc.) to obtain a desired level of conductivity. The metal spacer 11 is formed of conductive metal having elasticity. Particularly, a plate spring formed of copper, aluminum, or the like may be used as the metal spacer 11. Then, the metal spacer 11 repels the pressure which is applied by the internal substrate 2 and the chassis 4, and is adhered onto the surface of the chassis 4.

The pressure applied onto the metal spacer 11 can be adjusted, by adjusting the

distance (the clearance "B" shown in FIG. 2) between the chassis 4 and the base section 10. That is, the narrower the clearance "B" is, the more the pressure is applied to the metal spacer 11.

Accordingly, the metal spacer 11 of the earth connecting member 1 gets smaller upon application of pressure from the internal substrate 2 and the chassis 4, thereby the electric connection between the earth wiring 3 and the chassis 4 can reliably be obtained. The metal spacer 11 is pressed against and directly connected to the chassis 4. Hence, in this structure, the earth wiring 3 and the chassis 4 are connected with each other in a low impedance state. In other words, the earth wiring 3 and the chassis 4 can be connected in a low impedance state in the simple structure and using an easy connection method, and hence resulting in a high effect of restraining noises from occurring in the electronic unit.

An earth connecting member according to the second embodiment of the present invention will now be described with reference to the accompanying drawings.

The earth connecting member of the second embodiment connects, likewise the case of the first embodiment, electrically connects the earth wiring formed on the internal substrate with the chassis used as a compensating member for compensating for the area of the earth.

Note, however, that the structure of the earth connecting member and a method for fixing the earth connecting member onto the internal substrate are different from those of the first embodiment.

As shown in FIG. 5, the internal substrate 2 has an exposure windows 9 for exposing the earth wiring 3, formed on the front surface of the internal substrate 2, to the back surface of the internal substrate 2. An earth connecting member 21 is soldered to an exposing portion of the earth wiring 3, from the back surface of the internal substrate 2.

FIG. 6 is a diagram showing the structure of the earth connecting member 21.

The earth connecting member 21 comprises a base section 22 and a metal spacer 23, as illustrated in FIG. 6.

The base section 22 has a plurality of leads 24 which are soldered onto the earth wiring 3. Each of the plurality of leads 24 is wider than each of the leads 12 described in the first embodiment, and is bent as illustrated in FIG. 6. A tip part 24A from the bent portion of each lead 24 is parallel to the surface of the earth wiring 3, and is used as a margin left for soldering the lead 24 to the earth wiring 3. Hence, the connection area of the lead 24 and the earth wiring 3 is large. In this structure, the lead 24 can reliably be soldered to the earth wiring 3, even no through-hole 7 described in the first embodiment is prepared in the internal substrate 2.

The base section 22 is soldered to the earth wiring 3. Thus, likewise the first embodiment, the base section 22 (at least the lead 24) is formed from a material (e.g. copper, tin, etc.) which has conductivity and which can easily be adhered to solder.

The metal spacer 23 is substantially the same as the metal spacer 11 described in the first embodiment.

The earth connecting member 21 fixed on the internal substrate 2 is sandwiched between the internal substrate 2 and the chassis 4, likewise the first embodiment. Hence, in this structure, the earth connecting member 21 is pressed against and connected to the surface of the chassis 4.

Accordingly, the earth connecting member 21 is sandwiched between the internal substrate 2 and the chassis 4, thereby reliably connecting the earth wiring 3 and the chassis 4. Because the metal spacer 23 is pressed against and directly connected to the chassis 4, the earth wiring 3 and the chassis 4 are connected with each other in a low impedance state. In other words, the earth wiring 3 and the chassis 4 can be connected with each other in a low impedance state in the simple structure of the earth connecting member and using an easy connection method, and hence resulting in a high effect of restraining noises from occurring in the electronic unit.

The earth connecting member 1 described in the first embodiment may include a base section 30 shown in FIG. 7. The base section 30 has a plurality of leads 31 to be inserted into the through-holes 7. Each of the leads 31 is formed of a conductive material (e.g. copper, etc.), which has elasticity. As illustrated in FIG. 7, each of the leads 31 has a protruding portion 31A for fixing the earth connecting member 1 onto the internal substrate 2. As described above, each of the leads 31 is formed of conductive material having elasticity. Thus, the earth connecting member 1 can be fixed on the internal substrate 2 and the earth connecting member 1 can be connected to the earth wiring 3 only by inserting the leads 31 into the through-holes 7, without soldering the earth connecting member 1 to the earth wiring 3.

As described in FIG. 8, a plurality of earth connecting members 1 and 21 may be fixed on the same internal substrate 2. In this structure, the earth wiring 3 and the chassis 4 can electrically be connected at a plurality of points, and hence realizing a state where the impedance is lower than the cases of the first and second embodiments.

The cross section of the metal spacers 11 and 23 may be any form other than the triangle-like shape of the above-described first and second embodiments. For example, the cross section of the metal spacers 11 and 23 may be circular shown in FIG. 9A or may be a "Z"-like shape shown in FIG. 9B. Even in this case, the same effect as the above embodiments can be obtained. Note that if the cross section of the metal spacers 11 and 23 is the "Z"-like shape, the connection area between the metal spacers 11 and 23 and the chassis 4 is larger than the case where the cross section of the metal spacers 11 and 23 is triangular or circular, and hence realizing a state where the impedance is lower than the case where the cross section thereof is triangular or circular.

Each of the metal spacers 11 and 23 may be a coil spring, etc. as shown in FIG. 9C. Even in this structure, the same effect as that of the above embodiments can be obtained.

Various embodiments and changes may be made thereonto without departing from the broad spirit and scope of the invention. The above-described embodiments are

intended to illustrate the present invention, not to limit the scope of the present invention. The scope of the present invention is shown by the attached claims rather than the embodiments. Various modifications made within the meaning of an equivalent of the claims of the invention and within the claims are to be regarded to be in the scope of the present invention.

This application is based on Japanese Patent Application No. 2001-012470 filed on January 19, 2001, and including specification, claims, drawings and summary. The disclosure of the above Japanese Patent Application is incorporated herein by reference in its entirety.